

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

In re Application of :	§	Before the Examiner
Zhao et al.	§	James E. McDonough
Serial No. 10/693,584	§	Group Art Unit No. 1793
Filed: October 24, 2003	§	Attorney Docket Number: 2002B130/2
For: Late Transition Metal Catalysts for Olefin Oligomerizations	§	Confirmation Number 1077
	§	
Customer No.: 23455	§	Date: July 18, 2008

Commissioner for Patents  
P. O. Box 1450  
Alexandria, VA 22313-1450

**Declaration Under 37 C. F. R. § 1.132**

Dear Sir:

This affidavit is submitted to offer a showing that Claims 2-6 and 9-16 are both novel and non-obvious over Buchwald (US 6,307,087) in view of Qian (*Synthesis and Polymerization Behavior of Various Substituted Half-Sandwich Titanium Complexes Cp'TiCl<sub>2</sub>(OR\*) as Catalysts for Syndiotactic Polystyrene*, J. Mol. Cat. 208, 2004, 45-54.).

This declaration is submitted with a response to the Advisory Action dated July 7, 2008, along with an Information Disclosure Statement, as the submission required under 37 CFR § 1.114 for a Request for Continued Examination.

I, Jo Ann Marie Canich, Ph.D. declare that:

1. I am a citizen of the United States residing in Houston, Texas.
2. I am a co-inventor of the above-referenced patent application referred to herein as the '584 Patent Application.

3. I have been continuously employed by ExxonMobil Chemical Company, (and its predecessor Exxon Chemical Company) since 1987 as a research scientist working in the area of olefin catalysis. I have over twenty years of direct experience in the olefin catalysis art and, among other things, have recently published a book (co-editor) in the area of olefin catalysis (*Stereoselective Polymerization with Single-Site Catalysts*, Eds. Baugh & Canich, CRC Press, Boca Raton, FL, 2008). I have won multiple awards both inside my company and from industry for my work in the olefin catalysis field. Additional information regarding my technical and professional background is attached as a *Curriculum Vitae*.

4. I have read the Office Action dated February 22, 2008 and Advisory Action dated July 7, 2008, and have read each of the references cited therein, e.g. Buchwald and Qian.

5. In my opinion one of ordinary skill in the olefin catalysis art reading Buchwald would find that Buchwald is directed to catalysts useful to make small molecules via metal mediated coupling reactions, but not polymerization or oligomerization catalyst compounds. Furthermore, it is my opinion that the reference to "polymers" in Column 1, lines 16-20 is merely a general opening statement regarding the uses of transition metal catalyst compounds. In this sentence located in the "background of the invention" section, Buchwald in no manner implies that the catalysts of his invention are polymerization catalysts. In fact, in searching for the word "polymer", or a derivative of the word polymer, only 6 occurrences are found in the entire 55 page document. The second occurrence is on Column 16, line 56 where Buchwald again has a general statement regarding the use of synthetic schemes for aryl amines, biaryls, alpha-aryl ketones, and the like being useful to the agricultural, pharmaceutical and polymer industries. Again, this is simply a general statement, and in my opinion suggests that the coupling chemistry described in this patent can be used to add functionality to a polymer at most, i.e. performing coupling chemistry *with* polymers, not using coupling chemistry to *make* polymers. Furthermore, there is no indication, illustration or exemplification in the entire document that the coupling chemistry can be used to make polymers. Further in my opinion, even if one were to stretch one's imagination to the concept of using the catalysts for making polymer, one would be limited to making polymers containing aryl groups. All four reactions schemes discussed in the patent (see column 10, line 5, column 12, line 5, column 13,

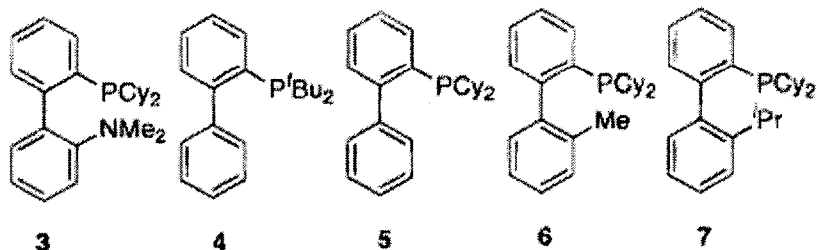
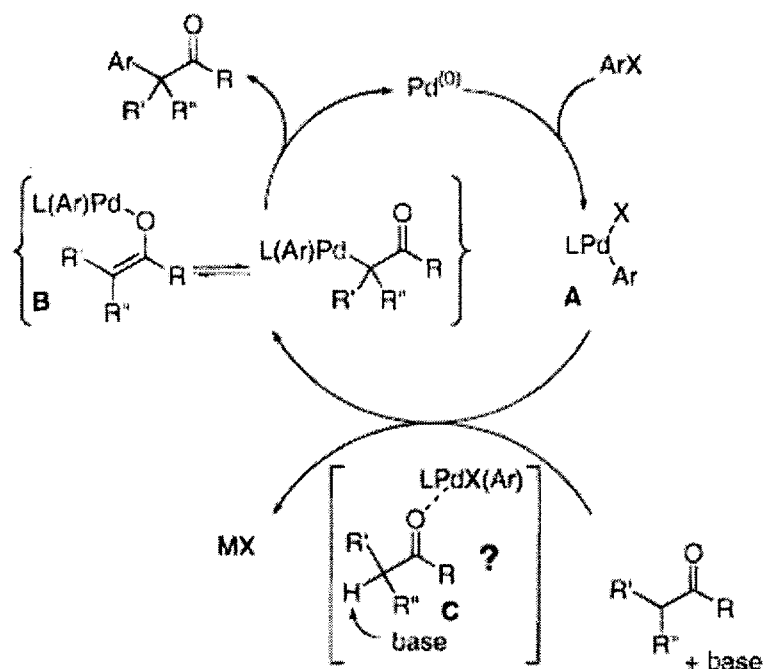
line 30, and column 14, line 60) and also claimed (see claims 19, 38, 50, and 62) involve the coupling of an aryl group to either an amine (Scheme 1), another aryl group (Scheme 2), an alkyl, heteroalkyl, or aralkyl (Scheme 3), or a ketone (Scheme 4). There is no mention or teaching of coupling an alpha-olefin with a second alpha-olefin, and there is certainly no mention of stringing more than two of any molecules together in any of these reaction schemes.

Besides the two occurrences of “polymer” discussed above, the remaining four are clearly related to polymer supports regarding supported Pd catalysts or polymer supported reactants which are typically used in combinatorial chemistry.

6. It is further my opinion that Buchwald does not disclose the pre-catalyst compounds or polymerization catalysts used in my patent application, and only discloses the use of the ligand in combination with a metal and a base such as an alkoxide, amide, phosphate, or carbonate. While the Examiner suggests that the reaction of the ligand with a metal will produce the pre-catalysts of my invention, this is not indicated in or supported by Buchwald.

In fact, if one refers to *Journal of the American Chemical Society* 2000, 122, 1360 (Fox et al.), Fox et al. shows the proposed reaction scheme (Scheme 1, page 1366 - also shown below) for a small molecule coupling reaction where the ligand, L, is shown in the chart on page 1362. The ligand labeled **3** can perform as an ancillary ligand where Y is biphenyl (referring to the formula in Claim 1 of the ‘584 application). On page 1366, Fox et al. states that in comparison to previous studies, that they believe the Pd:phosphine ratio when using ligands **4-7** for the reaction intermediates (**A** and **B**) is 1:1 (i.e. only one electron donating atom, in this case phosphorous, is needed). Note that ligands **4-7** are mono-dentate phosphorus ligands. Additionally, similar evidence suggests that the binding of the dimethylamino group of ligand **3** to Pd is not essential for the catalytic process and, in fact, may not occur at all. This is indicated by the similarities in the catalysis involved when using **3**, **6** and **7** in the Pd-catalyzed ketone arylations reported in the paper, in addition to Suzuki and amination reactions reported in references within. Note that ligands **6** and **7** do not contain the dimethylamino group as compared to ligand **3**. Hence, it would be speculative at best to assume that the reaction between ligand **3** and a metal would form the polymerization pre-catalyst of my invention, when the chemistry in small molecule coupling reactions suggests otherwise.

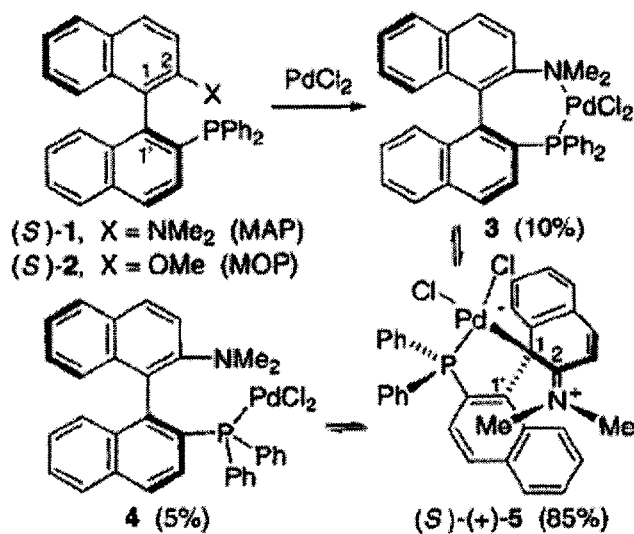
**Scheme 1**



Fox et al. also states that it is possible that the interaction between the metal and the ligand in the  $\text{Pd}(\text{II})$  intermediates complexes (**A** and **B**) is similar to those reported for the MOP and MAP ligands reported in *Journal of the American Chemical Society* 1999, 121, 7714 (Kocovsky et al.). Kocovsky et al. uses a binaphthyl ligand (not an ancillary ligand in my application). Scheme 1 of Kocovsky et al. is shown below (p 7714). Kocovsky et al. indicates an equilibrium between species **3** (10%), **4** (5%) and **5** (85%) in solution, however, they were only able to isolate compound **5**, suggesting the preferred state of the molecule is complex **5**. This is based not only on the ability to isolate complex **5** in crystalline form which was structurally characterized by X-ray crystallography, but also on the solution equilibrium mixture

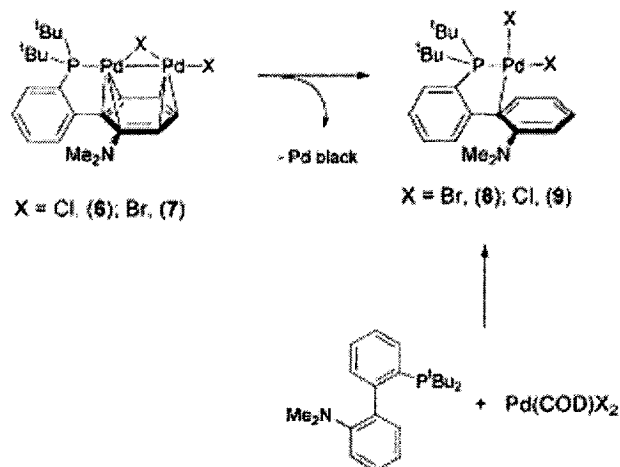
being 85% complex **5**. Note that complex **5**, and also complex **4**, does not have a metal-nitrogen bond as required of my ancillary ligand in the claims. Again, it would be speculative to assume the reaction between the ligand of Buchwald would react to make the complexes of our application verses assuming other chemistry as suggested by Kocovsky.

**Scheme 1**



Also noteworthy, is *Journal of the American Chemical Society* 2006, 128, 6376 (Christmann et al.) where reaction Scheme 3 illustrates two routes in making a palladium dihalide complex bearing a 2'-(di-tert-butylphosphino)-*N,N*-dimethylbiphenyl-2-amine ancillary ligand. Note that the reaction of the ligand with  $\text{Pd}(\text{COD})\text{X}_2$  where X is chlorine or bromine and COD is cyclooctadiene produces the Pd complexes labeled **8** and **9** wherein the Pd metal center is not bonded to the amine functionality of the ancillary ligand. Christmann et al. characterized complex **8** by X-ray crystallography, and both complexes were characterized by NMR.

**Scheme 3**



One should also note that the catalysis scheme for making small molecules via metal mediated catalysis as shown in Fox et al.'s Scheme 1 involves (1) starting with a Pd(0) complex and oxidizing it to Pd(II) by ArX to form intermediate **A**; (2) forming an interaction between intermediate **A** and an electron donor (a ketone in this case) in the presence of a base to form intermediate **C**; (3) abstraction of an acidic proton by the base to form intermediate **B**; and finally (4) reduction of intermediate **C** (Pd(II) down to Pd(0)) and formation of an arylated ketone. This is a catalytic cycle that involves multiple Pd species, and requires the ability to oxidize the metal to a higher oxidation state in order for the chemistry to occur, and then reduce the Pd back to Pd(0) to regenerate the catalyst and to "release" the new compound. The coupling mechanism for Buchwald is analogous to that represented by Fox et al. This is why Buchwald states in Column 32, line 7-8 that "the metal center is desirably in the zero-valent state or is capable of being reduced to metal (0)". The nickel and palladium species in my application are Ni(II) and Pd(II) and the catalytic cycle for olefin polymerization/oligomerization does not involve changing the oxidation state of the catalyst precursor, or of the catalyst species during the polymerization / oligomerization reaction.

7. Also interesting and noteworthy is that only nickel complexes bearing the 2'-(*dihydrocarbyl*-phosphino)-*N,N*-*dihydrocarbyl*-biphenyl-2-amine ancillary ligand recognized to date (July 11, 2008) by the Chemical Abstract Service (CAS) are [2'-(diphenylphosphino)-*N,N*-dimethylbiphenyl-2-amine]nickel(II) dibromide and [2'-(dicyclohexylphosphino)-*N,N*-dimethylbiphenyl-2-amine]nickel(II) dibromide

bearing registry numbers 685517-32-2 and 685517-31-1, respectively. The only references to these compounds are WO 2004/037869 and WO 2004/037837 which are related to my US '584 application. Also, while CAS now includes prophetic compounds in the registry as of Dec 12, 2007, these registry numbers and references are prior to the implementation of including prophetic compounds. Thus another in the art (i.e. the CAS) only recognized my art in the above referenced patent applications, and specifically not Buchwald, to have made the metal complexes as claimed in my '584 application.

8. It is further my opinion that Qian is directed to polymerizing styrene, not to oligomerizing or polymerizing alpha-olefins as in my application. As such, a trend seen in Qian can not necessarily be equated with a different type of polymerization process. Qian is focused on changing the Cp' or R\* of Cp'TiCl<sub>2</sub>(OR\*). Qian states, "In order to study how the changes of pi-donor ligand and sigma-donor ligand affect the catalytic activity and the properties of s-PS, this work aims to design and prepare a series of Cp'TiCl<sub>2</sub>(OR\*) complexes with different substituents in Cp and OR\*, and then to apply them to the production of s-PS." Since Cp'TiCl<sub>3</sub>/MAO is known to be a styrene polymerization catalyst, perhaps the Examiner is comparing the OR\* of Qian to Cl, but OR\* is not a hydrocarbyl, nor is it an abstractable ligand/leaving group in this catalyst system. The conclusion in Qian states, "through the polymerization testing we can conclude that the environment of cyclopentadiene plays a major role in the series of Cp'TiCl<sub>2</sub>(OR\*) /MAO catalytic systems, and that the influence of OR\* is relatively weak." Qian's conclusion does not mean that R\* has little effect, it means that in comparison to changing the substituents on the Cp ring, it has little effect for the polymerization of styrene.

Furthermore, it is commonly known in polymerization catalysis that changing the leaving group can affect catalyst activity, polymer molecular weight, and when applicable, polymer tacticity. For example, Kaminsky et al. reported that the styrene polymerization activity of fluorinated complexes Cp'TiF<sub>3</sub>/MAO (Cp' = Cp, Cp\*, MeCp, EtMe<sub>4</sub>Cp, etc.) was about 30-40 times higher than with analogous Cp'TiCl<sub>3</sub>/MAO systems. The polymer molecular weight, melting point and syndiotacticity were also significantly higher. This higher activity and syndioselectivity of the fluoride catalysts as compared to the chloride analogs is attributed to a greater number of more stable Ti(III) active sites where the fluoride

would be expected to better stabilize the Ti(III) oxidation state. See *Macromolecules* 1997, 30, 7647-7650. Similarly, in ethylene polymerization, McCullough et al. in US 6,632,901 report higher activity with  $\text{Cp}'_2\text{ZrF}_2$  is used as compared to  $\text{Cp}'_2\text{ZrCl}_2$  ( $\text{Cp}'=1,3\text{-Me,BuCp, Me}_4\text{Cp, n-PrCp, etc.}$ ) Similarly, Pedeutour et al. (*Journal of Molecular Catalysis A: Chemical* 2001, 176, 87-94) studied the effect of the leaving group for  $\text{rac-Et(Ind)}_2\text{ZrX}_2$  where X, the leaving group, was Cl, Me,  $\text{NMe}_2$  or  $\text{CH}_2\text{Ph}$ . In this study, it was found that when X was hydrocarbyl (Me or  $\text{CH}_2\text{Ph}$ ) that catalyst activity was not dependent on the MAO to pre-catalyst molar ratio (Al:Zr) over the range of about 150-2000. This was not the case for the Cl leaving group where the activity differed significantly from low Al:Zr of 150 (activity = 0) to a higher Al:Zr of 2000 (activity = 1290 kg/mol-hr). This study clearly shows that for a polymerization catalyst leaving group, hydrocarbyl is not equivalent to halide. Probably more relevant is US 7,247,687 (Cherkasov et al.) which deals with late transition metal polymerization catalysts. Cherkasov et al. demonstrate that the [1,4-bis-substituted)-1,4-diaza-1,3-butadiene]nickel(II) catecholate complexes are very different catalysts as compared to the dibromide analogs. Note that the two differ in the X leaving groups - two bromides vs. a chelating catecholate ligand. The dibromide complexes are known paramagnetic and typically hydrocarbon insoluble complexes while, the catecholate analogs are diamagnetic and hydrocarbon soluble (see column 2 for a discussion on paramagnetic complexes in the Background section and diamagnetic complexes in the Summary section). Comparison of the polymerization of a catecholate based catalyst vs. corresponding dibromide based catalyst (compare entries 8-11 with C6-C7 in Table 1, column 308) shows the catecholate to give higher activity as compared to the dibromide. While this study did not compare hydrocarbyl to halide, it does show that the nature of the leaving group affects catalyst activity in late transition metal catalyzed olefin polymerizations.

Since many examples exist to show that the leaving groups in olefin polymerization catalysis can have a major affect on catalyst activity, one skilled in the art would not assume that a hydrocarbyl leaving group is the same as a halogen leaving group in a nickel based catalyst system.

9. It is my further opinion that halogen ligands and hydrocarbyl ligands are not equivalent in all catalyst systems at all times. First halogen ligands are considered electron withdrawing, whereas hydrocarbyl ligands are typically



considered electron donating. Second, in many systems, a borate activator in combination with a halogenated catalyst precursor (e.g.  $\text{Cp}_2\text{ZrCl}_2$ ) produces an inactive system while an alkylated precursor (e.g.  $\text{Cp}_2\text{ZrMe}_2$ ) will likely, but not always, produce an active system. Thus, halogens and hydrocarbyls are not equivalent, particularly in borate activator containing systems.

10. In light of this lack of equivalence and the other statements above, it is my opinion that one of ordinary skill in the art would not combine Buchwald and Qian because firstly Qian is not directed at comparing hydrocarbyl verses halogen leaving groups, but is a study of ligand substitution on mono-cyclopentadienyl titanium catalysts for styrene polymerizations; and secondly, Buchwald is not directed to olefin polymerization catalysis, but rather to small molecule synthesis using late transition metal mediated coupling chemistry.

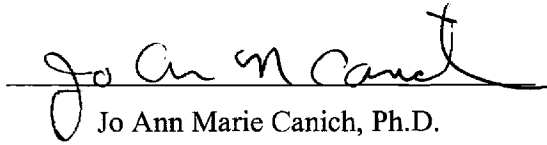
11. At the time the '584 application was filed, very few complexes used in catalyst systems were known that combined good catalyst activity with the production of linear olefins, with a particular preference for lower alpha-olefins. Additionally, the hydrocarbon solubility of my complexes (i.e. catalyst precursors) allowed for readily supporting the complexes to produce supported catalysts which can have advantages in certain processes, for example, a fixed bed process. And it is possible (but yet unproven) that the reason behind the unusual catalysis of my catalyst system, is that most four-coordinate Ni(II) complexes prefer the planar geometry since the planar ligand set allows for the d-electrons to avoid occupying antibonding orbitals. My Ni(II) four-coordinate complexes were determined to be tetrahedral in geometry meaning that d-electrons occupying the antibonding orbitals is unavoidable, hence the fact that these complexes are also paramagnetic.

12. In light of the above, it is my opinion as one of ordinary skill in the art that the foregoing clearly indicates that the catalyst described and claimed in my '584 Patent Application represents a technological break-through as perceived by those skilled in the field of transition metal catalysis.

13. *I declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both,*

*under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the patent.*

Date: July 18, 2008

  
Jo Ann Marie Canich, Ph.D.

# CURRICULUM VITAE

## JO ANN MARIE CANICH

**Office Address:** ExxonMobil Chemical Company  
Baytown Technology and Engineering Complex - West  
5200 Bayway Drive  
Baytown, TX 77520

**Industrial Positions:**

- ExxonMobil Chemical Company – Core Technology
  - Product Technology, Organometallic Catalysis Group (11/07-present)
    - Team Leader - Block Copolymers Team 1/08-present
  - Catalysis Process R&D, Organometallic Catalysis Group (1/07-11/07)
- Univation Technology: Catalyst R&D (1/04-1/07)
- Exxon or ExxonMobil Chemical Company – Core Technology
  - Catalysis Process R&D, Organometallic Catalysis Group (6/02-12/03)
    - Intellectual Property Coordination (12/02-12/03)
  - Polymer Science Division, Catalysis & Process Science Group (5/99-5/02)
  - Polymer Science Division, Solid State and Molecular Modeling Group (1/96-4/99)
    - Team Leader - Exploratory Catalyst Team 1/96-12/97
    - Team Leader - Solution Metallocene Elastomers Team (1/98-12/98)
  - Exxpol Catalysis Group (2/93-1/96)
  - Polymer Science Division, Catalysis Group (9/87-2/93)

**Awards:**

- ExxonMobil Chemical Company - CPR&D Research Award 2003
- American Society of Patent Holders Distinguished Corporate Inventors 1998
- Exxon Chemical Polymers Technology Award 1997
- Exxon Chemical, Baytown Polymers Center, Extra Mile Award 1995
- Exxon Chemical, Polymer Science, Where the Tire Meets the Road Award 1990
- Iota Sigma Pi National Anna Louise Hoffman Award 1987

**Education:**

8/84 - 5/87 Texas A&M University  
College Station, Texas  
Ph.D. Inorganic Chemistry (8/87)  
Advisor: F. A. Cotton  
Thesis: Oxidative Addition Chemistry of Group V and VI Metal Dimers

9/77 - 7/84 Portland State University  
Portland, Oregon  
M. S. Chemistry (6/84)  
B. S. Chemistry (6/81)  
Advisor; G. L. Gard  
Thesis: Derivatives of Trifluorosulfur Pentafluoride and F-(tert-butyl)  
Hypochlorite

**Publications:**

*Stereoselective Polymerization with Single-Site Catalysts*; Baugh, L.S., Canich, J.M., Eds.; CRC Press: Boca Raton, FL, 2008.

Zirconium complexes of cyclopenta[b]pyridine: synthesis, structure, and olefin polymerization catalysis. A. N. Ryabov, V. V. Izmer, A. A. Borisenko, J. M. Canich, L. G. Kuzmina, J. A. K. Howard, A. Z. Voskoboinikov, Journal of the Chemical Society, Dalton Transactions 2002, (15), 2995.

In situ X-ray absorption spectroscopy of olefin polymerization catalysts. P. Brant, J. M. Canich, P. T. Matsunaga, K. M. Squire, P. A. Stevens, B. DeVries, M. Sansone, E. I. Solomon, Abstr. Pap. – Am. Chem. Soc. 2001, 221<sup>st</sup>, INOR-052.

Metallocene-Catalyzed Copolymerization of Ethylene and Isobutylene to Substantially Alternating Copolymers. T. D. Shaffer, J. M. Canich and K. R. Squire, Macromolecules 1998, 31, 5145.

Preparation and Structure of  $[\text{Cl}_2\text{W}(\mu\text{-Cl})(\mu\text{-dmpm})_2(\mu\text{-PMe}_2)\text{WCl}(\eta^2\text{-CH}_2\text{PMe}_2)\text{Cl}]$ , a Product of an Unusual Cleavage of the dmpm Ligand. F. A. Cotton, J. M. Canich, R. L. Luck and K. Vidyasagar, Organometallics 1991, 10, 352.

"The Formation of the High Oxidation State Group-IB,- IIB, and Transition- and Inner-Transition-Metal Fluorides," *Inorganic Reactions and Methods*, J. M. Canich and G. L. Gard; A. Hagen Ed., VCH Publisher, 1991, V4, 2.11, 269-301.

Ethynylpentafluoro- $\lambda$ 6-sulfane ( $\text{SF}_5\text{CiCH}$ ). R. J. Terjeson, J. M. Canich and G. L. Gard, Inorg. Synth. 1990, 27, 329.

The Reactivity of  $\text{M}_2(\mu\text{-Cl})_2(\mu\text{-SMe}_2)\text{Cl}_4(\text{SMe}_2)_2$ : Formation of  $\text{Ta}_2(\mu\text{-SEt})_2(\mu\text{-Cl})\text{Cl}_4(\text{SMe}_2)_2$  and  $\text{NbCl}_3(\text{S}_2\text{CNET}_2)_2$ . J. M. Canich, F. A. Cotton, Inorg. Chim. Acta, 1989, 159, 163.

A Trinuclear Oxoniobium(V) Complex with Ketone Molecules as Ligands,  $[\text{NbOCl}_3(\text{OCR}'\text{R}')_3]$  with  $\text{R} = \text{C}_6\text{H}_5$  and  $\text{R}' = m\text{-CH}_3\text{C}_6\text{H}_4$ . J. M. Canich, F. A. Cotton and S. A. Duraj, Inorg. Chim. Acta 1989, 156, 41.

Reaction Chemistry of Compounds Containing Group 5 and 6 Multiple Metal-Metal Bonds: Formation of Edge-Sharing Bioctahedra. J. M. Canich, Diss. Abstr. Int. B 1988, 48, Pt. 1, 3562.

Binuclear Cationic  $\eta$ -bromo Complexes of Vanadium(II). J. M. Canich, F. A. Cotton, W. J. Roth and S. A. Duraj, Polyhedron 1988, 7, 737.

Reactions of tris(methyl sulfide)hexachlorodiniobium and -ditantalum with Compounds Containing Nitrogen-Nitrogen Single Bonds. J. M. Canich, F. A. Cotton, L. R. Falvello and S. A. Duraj, Inorg. Chim. Acta 1988, 143, 185.

Synthesis, Characterization, and Molecular Structure of the Quadruply Bonded Ditungsten(II) Complex,  $W_2Cl_4(dppm)_2$ . J. M. Canich and F. A. Cotton, Inorg. Chim. Acta 1988, 142, 69.

Oxidative-addition Reactions of Sulfur-Sulfur and Selenium-Selenium Bonds to Dimolybdenum and Ditungsten Quadruple Bonds. J. M. Canich, F. A. Cotton, K. R. Dunbar and L. R. Falvello, Inorg. Chem. 1988, 27, 804.

Phosphorus versus Nitrogen Donor Ligands in Edge-Sharing Bioctahedra of Niobium and Tantalum  $M_2Cl_6(L-L)_2$  Complexes. J. M. Canich and F. A. Cotton, Inorg. Chem. 1987, 26, 4236.

Further Study of Metal-Metal Bond Lengths in Homologous Edge-Sharing Bioctahedral Complexes. J. M. Canich, F. A. Cotton, L. M. Daniels and D. B. Lewis, Inorg. Chem. 1987, 26, 4046.

Structural and Theoretical Considerations in Tantalum and Niobium  $M_2Cl_6(SMe_2)_4$  and  $M_2Cl_6(dto)_2$  Complexes. J. M. Canich and F. A. Cotton, Inorg. Chem. 1987, 26, 3473.

Preparation and Structures of the Binuclear Vanadium(II) complexes  $[L_3V(\mu-Cl)_3VL_3]BPh_4$  with  $L$  = Tetrahydrofuran and 3-Methyltetrahydrofuran. J. M. Canich, F. A. Cotton, S. A. Duraj and W. J. Roth. Polyhedron 1987, 6, 1433.

The Preparation of  $Ta_2Cl_6(PhN)_2(Me_2S)_2$  by reaction of  $Ta_2Cl_6(Me_2S)_3$  with  $PhNNPh$  Crystal Structure of the Product. J. M. Canich, F. A. Cotton, S. A. Duraj and W. J. Roth. Polyhedron 1986, 5, 895.

Oxidative-Addition Reactions of F-tert-Butyl Hypochlorite with Perfluoromono- or Perfluorodiiodoalkanes, Pentafluoriodobenzene, and Hexafluorobenzene. J. M. Canich, M. E. Lerchen, G. L. Gard and J. M. Shreeve, Inorg. Chem. 1986, 25, 3030.

Oxidative Addition of Diphenyl Disulfide across a Ta=Ta Bond. Preparation and Characterization of  $[TaCl_3(Me_2S)]_2(\mu-SPh)_2$ . G. C. Cambell, J. M. Canich, F. A. Cotton, S. A. Duraj and J. F. Haw, Inorg. Chem. 1986, 25, 287.

Synthesis and Spectroscopic Properties of Ethylsulfur Pentafluoride (SF<sub>5</sub>SiCH<sub>3</sub>). J. M. Canich, M. M. Ludvig, G. L. Gard and J. M. Shreeve, *Inorg. Chem.* 1985, 24, 3668.

A Pentafluorosulfur β-Sultone and Some Derivatives. J. M. Canich, M. M. Ludvig, G. L. Gard and J. M. Shreeve, *Inorg. Chem.* 1984, 23, 4403.

Oxidative Displacement and Additive Reactions of F-tert-Butyl Hypochlorite with Metal Chlorides and Oxidative Additions to Several Elements. J. M. Canich, G. L. Gard and J. M. Shreeve, *Inorg. Chem.* 1984, 23, 441.

Derivatives of Trifluorovinylsulfurpentafluoride (SF<sub>5</sub>CF=CF<sub>2</sub>)II. R. Debuhr, J. Howbert, J. M. Canich, H. F. White and G. L. Gard, *J. Fluorine Chem.* 1982, 20, 515.

#### **US Patents, EP Patents and WO Applications:**

US RE40,234 E1 J. M. Canich, "Process for producing crystalline poly-α-olefins with a monocyclopentadienyl transition metal catalyst system," April 8, 2008

US 7,307,177 B2 Y. Qian, J. Huang, J. M. Canich, "Metallocene complexes, their synthesis and use in catalyst systems for olefin polymerization," December 11, 2007

EP 1110974 B1 D. J. Upton, G. G. Hlatky, J. M. Canich, H. W. Turner, "Method for preparing a supported activator component," November 28, 2007

US 7,294,681 B2 P. Jiang, A. H. Dekemzian, J. M. Canich, C. L. Sims, R. Abhari, C. A. Garcia-Franco, D. R. Johnsrud, "Multiple catalyst system for olefin polymerization and polymers produced therefrom," November 13, 2007

US 7,276,567 B2 A. Z. Voskoboynikov, A. Y. Lebedev, V. V. Izmer, A. N. Ryabov, M. V. Nikulin, J. M. Canich, "Heterocyclic substituted metallocene compounds for olefin polymerization," October 2, 2007

EP 1620447 B1 B. Zhao, E. Berluche, S. Kacker, J. M. Canich, "Soluble late transition metal catalysts for olefin oligomerizations III," August 8, 2007

EP 1603929 B1 B. Zhao, K. R. Squire, S. Kacker, J. M. Canich, "Soluble Group-10 alpha-diimine catalyst precursor," August 1, 2007

US 7,247,687 B2 V. K. Cherkasov, M. P. Bubnov, N. O. Druzhkov, V. N. Glushukova, I. A. Teplova, N. A. Skorodumova, G. A. Abakumov, C. A. Ballinger, K. R. Squire, J. M. Canich, E. Berluche, L. S. Baugh, D. N. Schulz, B. Zhao, "Late transition metal catalysts for olefin polymerization and oligomerization," July 24, 2007

WO 2007070038 A1 A. Z. Voskoboynikov, A. N. Ryabov, M. V. Nikulin, A. V. Lygin, V. V. Izmer, A. F. Asachenko, C. L Coker, J. M. Canich, "Halogen substituted metallocene compounds for olefin polymerization," June 21, 2007

WO 2007070040 A1 A. Z. Voskoboynikov, A. N. Ryabov, D. V. Uborsky, A. V. Lygin, C. L Coker, J. M. Canich, "Halogen substituted metallocene compounds for olefin polymerization," June 21, 2007

WO 2007070041 A1 C. L Coker, J. M. Canich, A. Z. Voskoboynikov, A. N. Ryabov, M. V. Nikulin, A. V. Lygin, "Halogen substituted metallocene compounds for olefin polymerization," June 21, 2007

WO 2007070045 A1 A. Z. Voskoboynikov, A. N. Ryabov, M. V. Nikulin, A. V. Lygin, C. L Coker, J. M. Canich, "Preparation of substituted bridged indenyl and related ligands," June 21, 2007

WO 2007070046 A1 A. Z. Voskoboynikov, A. N. Ryabov, M. V. Nikulin, A. V. Lygin, C. L Coker, J. M. Canich, "Halogen substituted heteroatom-containing metallocene compounds for olefin polymerization," June 21, 2007

US 7,223,822 B2 R. Abhari, C. L. Sims, P. Jiang, D. R. Johnsrud, J. M. Canich, "Multiple catalyst and reactor system for olefin polymerization and polymers produced therefrom," May 29, 2007

US 7,214,746 B2 A. Z. Voskoboynikov, D. N. Kazyulkin, V. V. Izmer, A. N. Ryabov, J. M. Canich, "Phosphorus bridged metallocene compounds for olefin polymerization," May 8, 2007

US 7,214,747 B2 A. Z. Voskoboynikov, D. N. Kazyulkin, V. V. Izmer, A. N. Ryabov, J. M. Canich, "Phosphorus substituted metallocene compounds for olefin polymerization," May 8, 2007

US 7,205,364 B1 J. M. Canich, "Olefin polymerization catalysts," April 17, 2007

WO 2007011459 A1 M. Wu, N. Yang, L. S. Baugh, J. M. Canich, S. P Rucker, J. F. Walzer, G. H. Lee, F. Y. Lo, A. Jackson, M. Hagemeister, S. Tirmizi, P. Jiang, C. S. Chee, "Polyalpha-olefin compositions and processes to produce the same," January 25, 2007

US 7,163,907 B1 J. M. Canich, H. W. Turner, G. G. Hlatky, "Aluminum-free monocyclopentadienyl metallocene catalysts for olefin polymerization," January 16, 2007

US 7,160,834 B2 B. Zhao, K. R. Squire, S. Kacker, J. M. Canich, "Soluble group-10  $\alpha$ -diimine catalyst precursors, catalysts and methods for dimerizing and oligomerizing olefins," January 9, 2007

US 7,161,018 B2 B. Zhao, E. Berluche, S. Kacker, J. M. Canich, "Soluble late transition metal catalysts for olefin oligomerizations II," January 9, 2007

EP 1513854 B1 B. Zhao, E. Berluche, S. Kacker, J. M. Canich, "Soluble late transition metal catalysts for olefin oligomerizations," November 29, 2006

US 7,084,223 B2 G. A. Vaughan, P. T. Matsunaga, D. E. Gindelberger, J. M. Canich, K. R. Squire, "Supported late transition metal catalyst systems," August 1, 2006

US 7,067,450 B2 B. Zhao, S. Kacker, J. M. Canich, E. Berluche, "Soluble late transition metal catalysts for olefin oligomerizations III," June 27, 2006

WO 2006065468 A1 Y. Qian, J. Huang, C. L. Coker, J. M. Canich, "Metallocene complexes, their synthesis and use in catalyst systems for olefin polymerization," June 22, 2006

WO 2006065809 A2 A. Z. Voskoboynikov, V. V. Izmer, A. F. Asachenko, M. V. Nikulin, A. N. Ryabov, A. Y. Lebedev, C. L. Coker, J. M. Canich, "Heteroatom bridged metallocene compounds for olefin polymerization," June 22, 2006

WO 2006065843 A2 A. Z. Voskoboynikov, M. V. Nikulin, V. V. Izmer, A. F. Asachenko, A. N. Ryabov, C. L. Coker, J. M. Canich, "Halogen substituted metallocene compounds for olefin polymerization," June 22, 2006

WO 2006065844 A2 A. Z. Voskoboynikov, A. N. Ryabov, C. L. Coker, J. M. Canich, "Process for producing substituted metallocene compounds for olefin polymerization," June 22, 2006

WO 2006065906 A2 C. L. Coker, J. M. Canich, A. Z. Voskoboynikov, A. N. Ryabov, M. V. Nikulin, V. V. Izmer, A. F. Asachenko, "Halogen substituted metallocene compounds for olefin polymerization," June 22, 2007

EP 1521758 B1 N. O. Druzhkov, I. A. Teplova, V. N. Glushakova, N. A. Skorodumova, G. A. Abakumov, B. Zhao, E. Berluche, D. N. Schulz, L. S. Baugh, C. A. Ballinger, K. R. Squire, J. M. Canich, M. P. Bubnov, V. K. Cherkasov, "Late transition metal catalysts for olefin polymerization and oligomerization," May 24, 2006

US 7,041,841 B1 J. M. Canich, "Process for producing crystalline poly- $\alpha$ -olefins with a monocyclopentadienyl transition metal catalyst system," May 9, 2006

US 7,037,989 B2 S. Kacker, T.D. Shaffer, J. M. Canich, E. Berluche, "Copolymers of ethylene and/or  $\alpha$ -olefins and vicinally disubstituted olefins," May 9, 2006

US 6,984,722 B2 J. N. Christopher, K. R. Squire, J. M. Canich, T. D. Shaffer, "Cationic group 3 catalyst system," January 10, 2006



WO 2005113622 A1 R. Abhari, C. L. Sims, P. Jiang, D. R. Johnsrud, J. M. Canich, "Multiple catalyst and reactor system for olefin polymerization and polymers produced therefrom," December 12, 2005

WO 2005108410 A1 A. Z. Voskoboynikov, D. N. Kazyulkin, V. V. Izmer, A. N. Ryabov, J. M. Canich, "Phosphorus substituted metallocene compounds for olefin polymerization," November 17, 2005

WO 2005108435 A1 A. Z. Voskoboynikov, D. N. Kazyulkin, V. V. Izmer, A. N. Ryabov, J. M. Canich, "Phosphorus bridged metallocene compounds for olefin polymerization," November 17, 2005

WO 2005108442 A1 P. Jiang, K. A. Nelson, C. L. Curry, A. Dekmezian, J. M. Canich, C. L. Sims, R. Abhari, C. A. Garcia-Franco, M. Knappes, M. L. Faisset, L. E. Jacob, "Polyolefin adhesive compositions and articles made therefrom," November 17, 2005

WO 2005100501 A1 R. Abhari, C. L. Sims, K. Lewtas, P. Brant, P. Jiang, W. Y. Chow, J. Schauder, C. Gong, D. R. Johnsrud, J. M. Canich, "Polyolefin adhesive compositions and articles made therefrom," October 27, 2005

EP 551277 B2 J. M. Canich, G. G. Hlatky, H. W. Turner, "Aluminum-free monocyclopentadienyl metallocene catalysts for olefin polymerization," March 9, 2005

WO 2004106394 A1 S. Kacker, E. Berluche, T. Schaffer, J. M. Canich, "Copolymers of ethylene and/or  $\alpha$ -olefins and vicinally disubstituted olefins," December 9, 2004

US 6,812,184 B1 G. A. Vaughan, J. M. Canich, P. T. Matsunaga, D. E. Gindelberger, K. R. Squire, K. R., "Supported late transition metal catalyst systems," November 2, 2004

WO 2004083224 A1 B. Zhao, K. R. Squire, S. Kacker, J. M. Canich, "Soluble Group-10  $\alpha$ -Diimine Catalyst Precursors," September 30, 2004

WO2004083224A1 B. Zhao, K. R. Squire, S. Kacker, J. M. Canich, "Soluble group-10  $\alpha$ -diimine catalyst precursors," September 30, 2004

WO 2004046214 A2 P. Jiang, A. Dekmezian, J. M. Canich, C. L. Sims, R. Abhari, C. A. Garcia-Franco, D. R. Johnsrud, "Multiple Catalyst System for Olefin Polymerization and Polymers Produced," June 3, 2004

WO 2004037869 A2 B. Zhao, S. Kacker, J. M. Canich, "Late Transition metal Catalysts for Olefin Oligomerizations," May 6, 2004

WO 2004037837 A1 B. Zhao, S. Kacker, J. M. Canich, "Late Transition metal Catalysts for Olefin Oligomerizations," May 6, 2004

WO 2004007509 A1 V. K. Cherkasov, N. O. Druzhkov, I. A. Teplova, V. N. Glushakova, N. A. Skorodumova, G. A. Abakumov, B. Zhao, E. Berluche, D. N. Schulz, L. S. Baugh, C. A. Ballinger, K. R. Squire, J. M. Canich, M. P. Bubnov, "Late Transition metal Catalysts for Olefin Polymerization and Oligomerization," January 22, 2004

US 6,677,441 J. N. Christopher, K. R. Squire, J. M. Canich, T. D. Shaffer, "Cationic Group 3 Catalyst System," January 13, 2004.

WO 2003102006 A1 B. Zhao, E. Berluche, S. Kacker, J. M. Canich, "Soluble Late Transition Metal Catalysts for Olefin Oligomerizations III," December 11, 2003.

WO 2003102005 A1 B. Zhao, E. Berluche, S. Kacker, J. M. Canich, "Soluble Late Transition Metal Catalysts for Olefin Oligomerizations," December 11, 2003.

US 6,638,887 J. M. Canich, "Monocyclopentadienyl Metal Compounds for Ethylene- $\alpha$ -Olefin Copolymer Production Catalysts," October 28, 2003.

US 6,632,898 J. M. Canich, "Monocyclopentadienyl Titanium Metal Compounds For Ethylene- $\alpha$ -Olefin Copolymer Production Catalysts," October 14, 2003.

US 6,617,466 J. M. Canich, "Monocyclopentadienyl Transition Metal Olefin Polymerization Catalysts," September 9, 2003.

EP 846705 B1 D. J. Crowther, R. A. Fisher, J. M. Canich, G. G. Hlatky, H. W. Turner, "Group 5 and 6 transition metal catalyst precursors," March 26, 2003

EP 907665 B1 G. A. Vaughan, J. M. Canich, P. T. Matsunaga, D. E. Gindelberger, K. R. Squire, "Supported late transition metal catalyst systems," January 22, 2003

US 6,492,473 J. M. Canich, G. A. Vaughan, P. T. Matsunaga, D. E. Gindelberger, T. D. Shaffer, K. R. Squire, "Mixed Transition Metal Catalyst Systems for Olefin Polymerizations," December 10, 2002.

US 6,455,458 J. M. Canich, "Tethered Monocyclopentadienyl Polymerization Catalysts," September 24, 2002.

US 6,423,795 J. M. Canich, H. W. Turner, G. G. Hlatky, "Tetramethylcyclopentadienyl Titanium Compounds for Ethylene- $\alpha$ -olefin Copolymer Production Catalysts," July 23, 2002.

US RE37788 E1 J. M. Canich, "Monocyclopentadienyl metal compounds for ethylene- $\alpha$ -olefin-copolymer production catalysts," July 9, 2002

US 6,403,773 J. N. Christopher, K. R. Squire, J. M. Canich, T. D. Shaffer, "Cationic Group 3 Catalyst System," June 11, 2002.

EP 672688 B2 J. M. Canich, G. G. Hlatky, H. W. Turner, "Aluminum-free monocyclopentadienyl metallocene catalysts for olefin polymerization," April 17, 2002

US 6,355,592 G. G. Hlatky, H. W. Turner, J. M. Canich, "Catalyst System of Enhanced Productivity and Its Use in Polymerization Process," March 12, 2002.

EP 548277 B1 Jo Ann M. Canich, "Process for producing crystalline poly-alpha-olefins with a monocyclopentadienyl transition metal catalyst," November 28, 2001

EP 702700 B1 D. J. Upton, J. M. Canich, G. G. Hlatky, H. W. Turner, "Supported ionic transition metal catalysts for olefin polymerization," November 7, 2001

EP 900242 B1 T. D. Shaffer, J. M. Canich, K. R. Squire, "Copolymers of ethylene and geminally disubstituted olefins," October 24, 2001

EP 766702 B1 G. A. Vaughan, A. N. Specca, P. Brant, J. M. Canich, "Polymerization catalyst systems, their production and use," October 17, 2001

US RE37,400 J. M. Canich, "Monocyclopentadienyl titanium Metal Compounds for Ethylene- $\alpha$ -olefin Copolymer Production Catalysts," October 2, 2001

US 6,294,625 G. G. Hlatky, H. W. Turner, J. M. Canich, "Catalyst System of Enhanced Productivity and Its Use in Polymerization Process," September 25, 2001

EP 766703 B1 J. M. Canich, "Monocyclopentadienyl metal compounds for ethylene- $\beta$ -olefin copolymer production catalysts," September 19, 2001

US 6,265,338 J. M. Canich, "Monocyclopentadienyl Titanium Complexes as Catalysts for Ethylene- $\alpha$ -olefin Copolymerization," July 24, 2001

US 6,255,410 H. Shigekazu, M. Sugawara, N. Baron, C. S. Speed, J. M. Canich, Howard Curtis Welborn, "Process for Polymerizing Olefinic Feeds Under Pressure." July 3, 2001

EP 906343 B1 J. M. Canich, G. A. Vaughan, P. T. Matsunaga, D. Gindelberger, T. D. Shafer, K. R. Squire, "Mixed transition metal catalyst systems for olefin polymerization," April 18, 2001

US 6,194,341 J. M. Canich, G. A. Vaughan, P. T. Matsunaga, D. E. Gindelberger, T. D. Shaffer, K. R. Squire, "Mixed Transition Metal Catalyst Systems for Olefin Polymerization." February 27, 2001

US 6,160,066 J. M. Canich, "Monocyclopentadienyl Metal Compounds for Ethylene- $\alpha$ -olefin Copolymer Production Catalysts," December 12, 2000

EP 618931 B2 J. M. Canich, "A modified monocyclopentadienyl transition metal/alumoxanes catalyst system for polymerization of olefins," November 2, 2000

EP 548257 B2 J. M. Canich, G. F. Licciardi, "Supported monocyclopentadienyl transition metal olefin polymerization catalysts," October 4, 2000

US 6,114,477 N. A. Merrill, J. M. Canich, A. H. Dekmezian, R. B. Pannell, Charles James Ruff, "Polymerization Process," September 5, 2000.

EP 906344 B1 P. T. Matsunaga, J. M. Canich, G. A. Vaughan, D. E. Gindelberger, R. S. Schiffino, D. R. Squire, R. B. Temme, "Elevated pressure polymerization processes with late transition metal catalyst systems," August 30, 2000

EP 420436 B2 J. M. Canich, "Olefin polymerization catalysts," July 19, 2000

EP 807143 B1 J. M. Canich, H. W. Yang, G. F. Licciardi, "Thermoplastic propylene elastomers and one pot/two catalysts process to produce them," March 15, 2000

US 5,955,625 J. M. Canich, "Monocyclopentadienyl Metal Compounds for Ethylene- $\alpha$ -olefin Copolymer Production Catalysts," September 21, 1999

WO 200018808 A1 J. N. Christopher, K. R. Squire, J. M. Canich, T. D. Shaffer "Cationic Group 3 Catalyst System," April 6, 2000

WO 2000002891 A1 J. M. Canich "Tethered Monocyclopentadienyl Transition Metal Catalysts," January 20, 2000.

EP 648230 B1 D. J. Crowther, R. A. Fisher, J. M. Canich, G. G. Hlatky, H. W. Turner, "Transition metal olefin polymerization catalysts," September 15, 1999

EP 668880 B1 G. G. Hlatky, J. M. Canich, H. W. Turner, "Polymerisation Process using a catalyst system of enhanced productivity," July 21, 1999

US 5,866,665 T. D. Shaffer, J. M. Canich, K. R. Squire "Copolymers of Ethylene and Geminally Disubstituted Olefins," February 2, 1999.

US 5,863,853 G. A. Vaughan, A. N. Specia, P. Brant, J. M. Canich "Polymerization Catalyst Systems, Their Production and Use," January 26, 1999

EP 705283 B1 J. M. Canich, "Process for producing amorphous poly- $\alpha$ -olefins with a monocyclopentadienyl transition metal catalyst system," January 13, 1999

EP 646140 B1 H. W. Turner, J. M. Canich, B. J. Folie, "High temperature polymerization process using ionic catalysts to produce polyolefins," December 30, 1998

EP 766704 B1 H. C. Welborn, J. F. Walzer, V. R. Sagar, E. E. Poirot, J. M. Canich, T. J. Burkhardt, "Polymerization process and catalyst systems useful therein," December 23, 1998

EP 788521 B1 A. K. Mehta, C. S. Speed, J. M. Canich, N. Baron, B. J. Folie, M. Sugawara, A. Watanabe, H. C. Welborn, "Long-chain branched polymer and their production," December 23, 1998

US 5,844,055 P. Brant, J. M. Canich, N. A. Merrill "Ethylene/Branched Olefin Copolymers," December 1, 1998

EP 641362 B1 P. Brant, J. M. Canich, N. A. Merrill "Ethylene/Branched Olefin Copolymers," November 11, 1998

US 5,763,556 T. D. Shaffer, J. M. Canich, K. R. Squire "Copolymers of Ethylene and Geminally Disubstituted Olefins," June 9, 1998

US 5,723,560 J. M. Canich "Higher Molecular Weight Amorphous Polypropylene," March 3, 1998

WO 1997048737 A1 P. T. Matsunaga, J. M. Canich, G. A. Vaughan, D. E. Gindelberger, R. S. Schiffino, K. R. Squire, R. B. Temme "Elevated Pressure Polymerization Processes with Late Transition Metal Catalyst Systems," December 24, 1997

WO 1997048736 A1 G. A. Vaughan, J. M. Canich, P. T. Matsunaga, D. E. Gindelberger, K. R. Squire "Supported Late Transition Metal Catalyst Systems," December 24, 1997

WO 1997048735 A1 J. M. Canich, G. A. Vaughan, P. T. Matsunaga, D. E. Gindelberger, T. D. Shaffer, K. R. Squire "Mixed Transition Metal Catalyst Systems for Olefin Polymerization," December 24, 1997

WO 1997044370 A1 T. D. Shaffer, J. M. Canich, K. R. Squire "Copolymers of Ethylene and Geminally Disubstituted Olefins," November 27, 1997.

WO 1997029138 A1 N. A. Merrill, J. M. Canich, A. H. Dekmezian, R. B. Pannell, C. J. Ruff, "Continuous Gas-phase Polymerization Process for Polymerizing Olefin(s) Utilizing a Metallocene Catalyst System," August 14, 1997

EP 616618 B1 P. Brant, J. M. Canich, "Ethylene/longer alpha-olefin copolymers," July 2, 1997

EP 615523 B1 N. Baron, S. Hayashi, M. Sugawara, J. M. Canich, C. S. Speed, H. C. Welborn, "Process for polymerizing olefinic feeds under pressure," June 25, 1997

US 5,635,573 B. A. Harrington, G. G. Hlatky, J. M. Canich and N. A. Merrill "Method for Preparing alpha-Olefin/Cycloolefin Copolymers," June 4, 1997

US 5,631,391 J. M. Canich "Monocyclopentadienyl Titanium Metal Compounds for Ethylene- $\alpha$ -olefin Copolymer Production Catalysts," May 20, 1997

US 5,621,126 J. M. Canich "Monocyclopentadienyl Metal Compounds for Ethylene- $\alpha$ -Olefin-Copolymer Production Catalysts," April 15, 1997

EP 491842 B1 J. M. Canich, "Monocyclopentadienyl transition metal olefin polymerization catalysts," April 9, 1997

EP 672688 B1 J. M. Canich, "Aluminum-free monocyclopentadienyl metallocene catalysts for olefin polymerization," September 18, 1996 18

WO 1996023838 A1 J. M. Canich, H. W. Yang, G. F. Licciardi, "Thermoplastic propylene elastomers and one pot/two catalysts process to produce them," August 8, 1996

US 5,539,056 H. W. Yang, J. M. Canich and G. F. Licciardi, "Flexible and Strong Amorphous/Crystalline Polypropylene Blend Compositions for Thermoplastic Elastomers," July 23, 1996

US 5,516,848 J. M. Canich, H. W. Yang and G. F. Licciardi, "Process for Producing Polypropylene Blends Having Elastomeric Properties," May 14, 1996

WO 1996012744 A1 A. K. Mehta, C. S. Speed, J. M. Canich, N. Baron, B. J. Folie, M. Sugawara, A. Watanabe and H. C. Welborn Jr., "Preparation of Long-chain Branched Polymers from Three Types of Monomers with Various Ziegler-Natta Polymerizable Bonds," May 2, 1996

US 5,504,169 J. M. Canich "Process for Producing Amorphous Poly- $\alpha$ -Olefins with a Monocyclopentadienyl Transition Metal Catalyst System," April 2, 1996

US 5,504,049 D. J. Crowther, R. A. Fisher, J. M. Canich, G. G. Hlatky and H. W. Turner, "Transition Metal of High Oxidation State for Olefin Polymerization Catalysts," April 2, 1996

US 5,502,124 D. J. Crowther, R/ A. Fisher, J. M. Canich, G. G. Hlatky and H/ W. Turner, "Transition Metal Olefin Polymerization Processes" issued March 26, 1996.

EP 569388 B1 J. M. Canich, H. W. Turner, "An amido transition metal compound and a catalyst system for the production of isotactic polypropylene," March 13, 1996

WO 1996000244 A1 J. M. Canich, "Monocyclopentadienylmetal Compounds for Ethylene-.alpha.-Olefin Copolymer Production Catalysts," January 4, 1996

WO 1996000245 A1 G. A. Vaughan, A. N. Specia, P. Brant and J. M. Canich, "Olefin Polymerization Catalyst Systems, their Production and Use," January 4, 1996

WO 1996000246 A1 H. C. Welborn Jr., J. F. Walzer, V. R. Sagar, E. E. Poirrot, J. M. Canich and T. J. Burkhardt, "Continuous Gas-phase Polymerization of Olefins in the Presence of Metallocene Catalysts," January 4, 1996

US 5,475,075 P. Brant and J. M. Canich, "Ethylene/Longer  $\alpha$ -olefin Copolymers," December 12, 1995

US 5,444,145 P. Brant, J. M. Canich and N. A. Merrill, "Ethylene/Branched Olefin Copolymers," issued August 22, 1995

US 5,420,217 J. M. Canich, "Process for Producing Amorphous Poly- $\alpha$ -olefins with a monoCyclopentadienyl Transition Metal Catalyst System," May 30, 1995

WO 1995000562 A1 J. M. Canich, "Process for producing amorphous poly-alpha-olefins with a monocyclopentadienyl transition metal catalyst system," January 5, 1995

WO 1994007927 A1 G. G. Hlatky, J. M. Canich, H. W. Turner, "Catalyst system of enhanced productivity and its use in polymerization process," April 14, 1994

WO 1994007930 A1 P. Brant, J. M. Canich, A. J. Dias, R. L. Bamberger, G. F. Licciardi, P. M. Henrichs, "Long chain branched polymers and a process to make long chain branched polymers," April 14, 1994

US 5,408,017 H. W. Turner, J. M. Canich and B. J. Folie "High Temperature Polymerization Process using Ionic Catalysts to Produce Polyolefins," April 18, 1995

US 5,318,935 J. M. Canich and H. W. Turner, "Amido Transition Metal Compound and a Catalyst System for the Production of Isotactic Polypropylene," June 7, 1994.

WO 1994003506 A1 D. J. Upton, J. M. Canich, G. G. Hlatky and H. W. Turner, "Supported Ionic Transition Metal Catalysts and their Manufacture for Olefin Polymerization," February 17, 1994

WO 1994001471 A1 D. J. Crowther, R. A. Fisher, J. M. Canich, G. G. Hlatky, H. W. Turner, "Transition metal olefin polymerization catalysts," January 20, 1994

WO 1994000500 A1 R. B. Pannell, J. M. Canich and G. G. Hlatky, "Solution Phase Polymerization Utilizing Metallocene Catalysts with Production of Olefin Polymers," January 6, 1994

WO 1993025590 A1 H. W. Turner, J. M. Canich, B. J. Folie, "High temperature polymerization process using ionic catalysts to produce polyolefins," December 23, 1993

WO 1993021242 A1 P. Brant, J. M. Canich and N. A. Merrill, "Ethylene-branched Olefin Copolymers," October 28, 1993

US 5,264,405 J. M. Canich, "Monocyclopentadienyl Titanium Metal Compounds for Ethylene- $\alpha$ -olefin-copolymer Production Catalysts," November 23, 1993

WO 1993019103 A1 H. W. Turner, G. G. Hlatky and J. M. Canich, "Ionic Catalyst for the Production of Poly- $\alpha$ -olefins of Controlled Tacticity," September 30, 1993

US 5,227,440 J. M. Canich and Gary F. Licciardi, "Mono-Cp Heteroatom Containing Group IVB Transition Metal Complexes with MAO: Supported Catalysts for Olefin Polymerization," July 13, 1993.

WO 1993013140 A1 J. M. Canich, "A Modified Monocyclopentadienyl Transition Metal/Aluminoxane Catalyst System for Polymerization of Olefins," July 8, 1993

WO 1993012151 A1 P. Brant and J. M. Canich, "Copolymers of Ethylene and Higher  $\alpha$ -olefins and Catalysts for their preparation," June 24, 1993

WO 1993011171 A1 N. Baron, S. Hayashi, M. Sugawara, J. M. Canich, C. S. Speed and H. C. Welborn, "Process for Polymerizing Olefinic Feeds Under Pressure," June 10, 1993

WO 1992012162 A1 J. M. Canich and H. W. Turner, "New Amido Transition Metal Compounds," July 23, 1992

WO 1992005204 A1 J. M. Canich, "Process for producing crystalline poly- $\alpha$ -olefins with a monocyclopentadienyl transition metal catalyst system," April 2, 1992

WO 1992005203 A1 J. M. Canich, G. F. Licciardi, "Supported monocyclopentadienyl transition metal olefin polymerization catalysts," April 2, 1992

US 5,096,867 J. M. Canich, "Monocyclopentadienyl Transition Metal Olefin Polymerization Catalysts," March 17, 1992

WO 1992001006 A1 J. M. Canich, "Group IVB, VB and VIB metal hydrocarboxides, with alumoxanes for olefin polymerization," January 23, 1992



WO 9200333 A2 J. M. Canich, G. G. Hlatky and H. W. Turner,  
"Monocyclopentadienyl Metallocene Catalyst for Olefin Polymerization," January  
9, 1992

US 5,079,205 J. M. Canich, "Group IVB, VB and VIB Metal Hydrocarbyloxides  
with Alumoxane for Olefin Polymerization," January 7, 1992

US 5,057,475 J. M. Canich and G. F. Licciardi, "Mono-Cp Heteroatom  
Containing Group IVB Transition Metal Complexes with MAO: Supported  
Catalysts for Olefin Polymerization," October 15, 1991.

US 5,055,438 J. M. Canich, "Olefin Polymerization Catalysts," October 8, 1991

US 5,026,798 J. M. Canich, "Process for Producing Crystalline Poly- $\alpha$ -Olefins  
with a Monocyclopentadienyl Transition Metal Catalyst System," June 25, 1991

WO 9104257 J. M. Canich, "Olefin Polymerization Catalysts," April 4, 1991

#### **External Presentations:**

Copolymers of Ethylene and 2-Butenes using Cp-Amido Titanium Catalysts J. M. Canich NSF Inorganic Chemistry Workshop, Blaine, Washington, June 2006

Single-Site Catalysts for Olefin Polymerization J. M. Canich Florida Institute of  
Technology, Melbourne, Florida, March 1998 (Oak Ridge Associated Universities  
Visiting Industrial Scholar)

Single-Site Catalysts for Olefin Polymerization J. M. Canich Southwest Regional  
ACS Meeting, Houston, Texas 1996

Single-Site Catalysts for Olefin Polymerization J. M. Canich Inorganic Gordon  
Conference, Henniker, New Hampshire 1996

Organometallic Approaches to Ziegler-Natta Polymerizations of Olefins J. M. Canich NSF Organometallic Workshop, Queenstown, MD 1995 (Note: This was  
a different talk than the previous ones with the same title.)

Organometallic Approaches to Ziegler-Natta Polymerizations of Olefins J. M. Canich Contemporary Inorganic Chemistry: A symposium in Honor of F. A.  
Cotton, College Station, Texas 1995 (Note: This was a different talk than the  
previous one with the same title.)

Organometallic Approaches to Ziegler-Natta Polymerizations of Olefins. J. M. Canich. Organometallic Gordon Conference, New Port, Rhode Island 1992.

Reaction Chemistry of Compounds Containing Group 5 and 6 Multiple Metal-  
Metal Bonds: Formation of Edge-Sharing Biocahedra. J. M. Canich. Iota Sigma  
Pi - Neptunium Chapter Meeting, Houston, Texas 1987.

Structural and Theoretical Considerations in Tantalum and Niobium  $M_2Cl_6(SMe_2)_4$  and  $M_2Cl_6(dto)_2$  Complexes. J. M. Canich and F. A. Cotton. 192nd National Meeting, Anaheim, California 1986.

A New  $d^1-d^1$  Ditantalum Complex Containing Two Thiophenolate Bridges, Six Terminal Chlorine Atoms and Two Terminal Dimethyl Sulfide Molecules. J. M. Canich, F. A. Cotton and S. A. Duraj. 190th ACS National Meeting, Chicago, Illinois 1985.

Networking (Panel Member). Iota Sigma Pi Triennial Convention, Portland, Oregon 1984.

Chemistry of Stable Perfluorinated Hypochlorites-F-(tert-Butyl)Hypochlorite. J. M. Canich, G. L. Gard and J. M. Shreeve. 39th ACS Northwest Regional Meeting, Moscow, Idaho 1984.

Derivatives of Trifluorovinyl Pentafluoride. R. DeBuhr, J. Howbert, J. M. Canich, H. F. White and G. L. Gard, 37th Northwest Regional Meeting, Eugene, Oregon 1982.